CHAPTER – VII
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SUMMARY, CONCLUSIONS AND
SUGGESTIONS FOR FURTHER RESEARCH

7.1 INTRODUCTION

Education is the main instrument for any social change and the science education plays a vital role in any educational system. Time and again our educational committees, commissions and policies have identified the place and importance of science education. It is only through the development of scientific attitude among the students, we, the teachers will be able to develop and nourish the all round personality of our students.

National Policy on Education (1986) had recommended that science education will be strengthened to develop in the child well defined abilities and values such as spirit of enquiry, creativity, objectivity and courage to question. In other words, efforts will be made to develop scientific temper or attitude among the children.

Many educationists have pointed out that knowledge about scientific facts and skills in the use of scientific methods are of little value if there is no inclination to use them. The scientific attitude represents the motivation which converts this knowledge and skill into action and refers to a willingness to use scientific procedures and methods. It may best be described as “an attitude to ideas and information to particular ways of evaluating them”, a formulation which distinguishes it from “an attitude to science or scientists” on the one hand and from “an ability to carry out scientific procedures” on the other. Major statements of the goals of science
education in the USA have consistently stressed the importance of developing scientific attitude in students. However, there is a deal of evidence that little emphasis is placed on this aim in the classroom, apparently because methods for teaching and testing attitudes may not be widely available.

For many science educators the importance of the scientific attitude is so obvious that no argument is required to support its inclusion among those which a school science course should aim to develop in students. It may be obvious that the scientific attitude is important in the professional lives of scientists and the students learning about science and thus should also become aware of the motive power which impels scientists in their work. It is argued that an effective way of learning about the nature of scientific activity is for the student to act out the role of scientist in the classroom. The student who enters this role fully will be the one who adopts for himself the attitude which also motivated the scientist (Nay & Crocker, 1970). Secondly, scientific attitudes represent desirable personal attributes for all people. The tendency to be accurate, intellectually honest, open minded, objective and to demand reliable empirical evidence before making decisions may be most clearly seen in the problem solving activity of scientists but they also represent predispositions appropriate for solving problems in everyday life as well. Under the influence of such attitudes as these, it is claimed that problems will be approached in a manner which is more likely to lead to successful solutions (Noll, 1933). For the Educational Policies Commission (1966) possession of the scientific attitude is not only the mark of a scientifically-minded person, but also the sign of a rational one. These benefits of a scientific education are primarily for the individual but a number of writers have claimed additional benefits for the society.
As we consider the future responsibilities of citizens we will probably agree that helping children to become more cooperative, more responsible, more 'open-minded', and at the same time, more critical minded is certainly worth the effort (Henry, 1947).

Godson (1976) conducted a study on the scientific attitude of college students. The results indicated that there was a significant difference in the scientific attitude of college male and female students.

Mitra (1978) also found that scientific interest was highly related with probabilities of success in the higher secondary course.

Sibia (1989) found a significant relationship between verbal intelligence and achievement in science.

Rao (1990) aimed at determining the relationship among scientific attitude, science aptitude and achievement in biology which were found by him to be scientifically related to each other.

Sharma (1990) studied scientific literacy, attitude towards science and personality traits of student teachers and observed significant positive correlation between science literacy and attitude towards science.

Malviya (1991) examined attitude towards science and interest in science. The study showed that high scores on attitude towards science favour higher scientific interest.

Malviya (1991) also studied attitude towards science and interest in science and found with minor differences here and there, age and sex have no effect on attitude towards science.

Rao, Aruna, Rao and Rathaioh (1997) in their study on 68 prospective science teachers concluded that their scientific attitudes are low; they are tending more towards personality traits of assertive and independent.
Kaur (2002) found a positive and significant relationship between intelligence and scientific attitude of IX class students.

Ingram (2003) found no significant difference between males and females in their beliefs about science from the attitude survey.

7.2 RATIONALE OF THE PROBLEM

The formation of scientific attitude is a process that starts right from the very beginning in the immediate environment provided by parents, friends, neighbourhood, teachers, school and society at large. Although there are few studies on the relationship of achievement and scientific attitude, SES and scientific attitude and sex differences, yet these studies are scarce, insufficient and inadequate in themselves to make any generalizations regarding the role of these factors in the development of scientific attitude.

Moreover, studies in the field of relationship of scientific attitude with personality traits; cognitive variables such as intelligence and achievement motivation and relationship of affective variables such as attitude towards education, parent-child interaction and also certain background variables such as management of schools, medium of instruction etc. are practically inaccessible. Relationships of scientific attitude with cognitive variables have been explored by a few researchers but these studies are available on perspective teachers. No one has tried to link the personality traits, cognitive and affective variables with the scientific attitude of secondary school students in detail and depth. Thus seeing the gaps and voids in the research literature, the investigator planned this investigation.
7.3 STATEMENT OF THE PROBLEM

The study under investigation was stated as, “Scientific attitude in relation to certain personality traits, cognitive and affective variables”.

7.4 OBJECTIVES OF THE STUDY

1. To find out the degree of association between the variables of scientific attitude and personality traits E (humble vs. assertive, independent), M (practical vs. imaginative) and Qi (conservative vs. experimenting).

2. To find the relationship of scientific attitude with the cognitive variables of intelligence, achievement in science and achievement motivation.

3. To find the relationship of scientific attitude with the affective variables of interest in science, attitude towards education and parent-child relationship.

4. To examine the difference in the scientific attitude of the students on account of sex-differences, medium of instruction and differences in the school management.

7.5 HYPOTHESES

1. There will be a significant relationship between scientific attitude and personality traits E (humble vs. assertive, independent), M (practical vs. imaginative) and Qi (conservative vs. experimenting).

2 (a) Variable of intelligence correlates significantly with the scientific attitude of the students.

2 (b) Variable of achievement in science correlates significantly with the scientific attitude of the students.
2 (c) Variable of achievement-motivation correlates significantly with the scientific attitude of the students.

3 (a) Variable of interest in science correlates significantly with the scientific attitude of the students.

3 (b) Variable of attitude towards education correlates significantly with the scientific attitude of the students.

3 (c) Variable of parent child interaction correlates significantly with the scientific attitude of the students.

4 (a) There will be no significant difference in the scientific attitude of girls and boys.

4 (b) There will be no significant difference in the scientific attitude of students on the basis of medium of instruction i.e. Hindi, English and Punjabi.

4 (c) There will be no significant difference in the scientific attitude of students studying in the government, government-aided, private schools and navodaya vidyalayas.

7.6 DELIMITATIONS OF THE STUDY

1. The present study was delimited to IX class students studying in government, government-aided, private schools and navodaya vidyalayas.

2. The study was restricted to Punjab state only.

3. The study as restricted to 789 students (for government, government-aided, private schools and navodaya vidyalayas) selected on the basis of randomization technique.
7.7 DESIGN OF THE STUDY
In the first phase of the study all the proposed standardized tools were obtained and data was collected. In the second phase of the study, the collected data was subjected to various statistical techniques to draw inferences.

7.8 METHOD OF THE STUDY
Survey method of investigation was employed in the present study.

7.9 SAMPLE
Randomisation technique of sampling was employed in the present study. Present study was conducted on a sample of 789 students from government, government-aided, private schools and navodaya vidyalayas.

7.10 TOOLS
1. Scientific Attitude Scale (Kaur, 2002).
2. 16 PF Questionnaire (Cattell and Eber, Indian Adaptation by Kapoor and Tripathi, 1981).
4. Achievement in Science (This was noted down from the VIII Class final results of the students).
5. Achievement Motivation Inventory (Deo and Mohan, 1985).
7. Attitude Scale Towards Education (Chopra, 1982).
7.11 STATISTICAL TECHNIQUES

The following statistical techniques were used:-
1. Product Moment coefficient of correlation
2. Mean, SD, F-ratio and ‘t’ ratios.

7.12 DEFINITIONS AND EXPLANATIONS OF THE TERMS USED

1. **Scientific Attitude**: Scientific attitude may be defined as “open-mindedness”, a desire for accurate knowledge, confidence in procedure for seeking knowledge and the expectation that the solution of the problem will come through the used of verified knowledge. The major components of the scientific attitude are: rationality, curiosity, open-mindedness, aversion to superstition, objectivity-intellectual honesty and suspended judgment.

2. **Personality Traits**: In the present study, the relationship of only three personality traits i.e. E (humble vs. assertive, independent), M (practical vs. imaginative) and Qi (conservative vs. experimenting nature) with the scientific attitude of the students were explored.

3. **Cognitive Variables**: In the present study only three cognitive variables i.e. intelligence, achievement in science and achievement motivation were taken up.

   (a) **Intelligence**: In general, intelligence can be defined as the ability to solve problems, ability to learn and ability to adapt to novel situations.

   (b) **Achievement**: Achievement means the end gained or level of success attained by an individual or group on the completion of a task. It can be academic, manual, personal or social. Here achievement in science is being taken as one of the cognitive variables.
4. Affective Variables: Affective variables in the present study were interest in science, parent child relationship and attitude towards education.

(a) Interest: Interest is one of the important traits of the personality of an individual which have significance for educational and vocational success and satisfaction. These traits are manifested as likes, dislikes, indifferences, preferences and evaluation.

(b) Parent-child relationship: Parent-child relationship is termed as interaction between parents and the child. The parents occupy the most crucial role in the development of the child. The values, beliefs and attitude of parents definitely influence the behaviour, growth and outlook of children.

(c) Attitude towards education: Attitudes have been defined as ideas with emotional content, important beliefs, prejudices, biases, predispositions, appreciations and as a state of readiness or set.

5. Background Variables: In addition to the above variables, three background variables i.e. sex, type of management and medium of instruction were taken up and their effect on the development of scientific attitude among students was studied.

7.13 NEED AND IMPORTANCE OF THE STUDY

Ours is an age of science. Hence, it is essential for every individual to have a correct knowledge of scientific age. To achieve this important aim, education should be organized in such a way that
each child is inspired to participate actively in the economic reconstruction of society. They should understand the development of modern society, which in turn depends upon the development of science and technology. Every advancement in science deepens our understanding of nature and it also heightens the scientific knowledge. To understand the world around us and to improve the quality of life of the society, youth today needs scientific attitude.

Development of scientific attitude is considered as the basic goal of teaching of science, no less important than cognitive goals. The more developed is the scientific attitude of an individual with regard to a particular idea or object, the more objective his decisions and conclusions become on the basis of his tested data.

Present study will add to the existing ocean of knowledge as it identifies the factors which go with the scientific attitude of the students studying at the secondary stage.

Moreover relationships of scientific attitude with cognitive variables have been explored by a few researchers but these studies are available on perspective teachers. No one has tried to link the personality traits, cognitive and affective variables with the scientific attitude of secondary school students in detail and depth, thus leaving ample scope for the exploration of this field of research.
7.14 CONCLUSIONS

Researcher has drawn following conclusions on the basis of analysis of data, interpretation and discussion of results.

Correlation

1. Dependent variable of scientific attitude was insignificantly correlated with the Factor E (humble vs assertive) of personality and significantly correlated with Factor M (practical vs imaginative) and factor Q1, (conservative vs experimenting) of personality.

   Thus the hypothesis 1(a) that there will be a significant relationship between scientific attitude and personality trait E(humble vs assertive) was not retained and hypotheses 1(b) and (c) that there will be a significant relationship between scientific attitude and personality trait M (practical vs imaginative) and personality trait Q1, (conservative vs experimenting) respectively were retained in the present study.

2. Variable of intelligence is positively and significantly correlated with the variable of scientific attitude of students at 0.05 level. In other words the intellectual ability has close association with the scientific attitude of the students.

   Thus, hypothesis 2 (a) that variable of intelligence correlates significantly with the scientific attitude of the students was retained in the present study.
3. Independent variable of achievement in science was found to be insignificantly correlated with the dependent variable of scientific attitude at 0.05 level of significance. Thus the variable of achievement in science and scientific attitude are independent of each other. Thus the hypothesis 2 (b) that variable of achievement in science correlates significantly with the scientific attitude of the students was not retained here.

4. Variable of achievement motivation was found to be insignificantly correlated with the variable of scientific attitude at 0.05 level of significance. Thus the variable of achievement motivation and scientific attitude are independent of each other. Thus the hypothesis 2 (c) that variable of achievement motivation correlates significantly with the scientific attitude of the students was not retained here.

5. A significant positive correlation was obtained at 0.05 level between the independent variable of interest in science and dependent variable of scientific attitude. In other words, interest of the students in scientific activities is a powerful determinant in deciding their scientific attitude. Thus the hypothesis 3 (a) that the variable of interest in science correlates significantly with the scientific attitude of students was retained.

6. Independent variable of attitude towards education was found to be insignificantly correlated with the dependent variable of scientific
attitude at 0.05 level of significance. Thus the variable of attitude
towards education and scientific attitude are independent of each
other.

Thus the hypothesis 3 (b) that variable of attitude towards
education correlates significantly with the scientific attitude of the
students was not retained here.

7. The variable of parent child relationship is found to be significantly
and positively correlated with the criterion measure of scientific
attitude at 0.05 level of significance Thus, a better and healthy parent
child relationship leads to foster scientific attitude among children.

Hence, hypothesis 3(c) that variable of parent child relationship
correlates significantly with the scientific attitude of the students was
accepted in the present study.

t-ratios

1. It is noticed that when the scientific attitude of boys and girls is
compared, insignificant mean difference is obtained in scientific
attitude of boys and girls at 0.05 level. It means sex differences do
not affect the scientific attitude of the students.

Thus the hypothesis 4 (a) that there will be no significant
difference in the scientific attitude of girls and boys was retained in
the present study.

2. In the present study, when scientific attitude of three groups on the
basis of medium of instruction were compared, F-value was found
be significant at .01 level, therefore further groups were compared by finding t-ratios.

3. From the results of the present study, it was revealed that significant differences were obtained between the mean scores of students studying in Hindi and English medium on the variable of scientific attitude. Further, mean scores of English medium students on scientific attitude was higher as compared to Hindi medium students. In other words, English medium students have more favourable scientific attitude as compared to Hindi medium students.

Thus, hypothesis 4(b)\(^1\) that there will no significant difference in the scientific attitude of the students studying in Hindi and English medium was not retained in the present study.

4. It is revealed that there was a significant difference in the scientific attitude of students studying in English and Punjabi medium schools at 0.01 level of significance. The mean scores of scientific attitude in case of English medium students was higher as compared to Punjabi medium students.

Thus, hypotheses 4(b) that there will be no significant difference in the scientific attitude of the students studying in English and Punjabi medium was not retained in the present study.

5. Results of the present study disclose a significant difference in the scientific attitude of the students studying in Hindi and Punjabi medium schools at 0.01 level of significance. The mean scores of
the scientific attitude of students studying in Hindi medium was higher as compared to those studying in Punjabi medium.

Thus, hypotheses 4 (b)\textsuperscript{111} that there will be no significant difference in the scientific attitude of the students studying in Hindi and Punjabi medium was not retained in the present study.

6. The $F$ value was found to be significant at .01 level when the scientific attitude was compared on the basis of type of management in the school. Further groups were compared by finding t-ratios.

7. The results revealed that insignificant difference exists between the mean scores of two groups, government and government-aided school students on the dependent variable of scientific attitude due to insignificant t-value at 0.05 level.

Hence, hypothesis 4(c)\textsuperscript{1} that there will be no significant difference in the scientific attitude of the students studying in government and government-aided school was retained in the present study.

8. From the results of the present study, it was noticed that significant difference was obtained between the mean scores of government and private school students on the variable of scientific attitude. The mean scores of private school students was higher as compared to government school students. Thus, the students of private schools certainly have better developed scientific attitude as compared to government school students.
Thus, hypotheses 4 (c)\textsuperscript{11} that there will be no significant difference in the scientific attitude of the students studying in government and private school was not retained here.

9. Results of the present study also disclose significant differences which are obtained between the mean scores of government schools and Navodaya Vidyalayas on the variable of scientific attitude. The mean scores of Navodaya Vidyalayas students are higher as compared to government school students. Thus, the students of Navodaya Vidyalayas have a better developed scientific attitude as compared to government school students.

Thus hypotheses 4 (c)\textsuperscript{11} that there will be no significant difference in the scientific attitude of the students studying in government schools and Navodaya Vidyalayas was not retained here.

10. It was also noticed that when the scientific attitude of the students studying in government aided and private schools are compared, a significant mean difference was obtained at 0.01 level. Moreover, the mean scores of scientific attitude of private school students was higher as compared to government aided school students.

Thus hypotheses 4 (c)\textsuperscript{11} that there will be no significant difference in the scientific attitude of the students studying in government aided and private schools were also not retained here.

11. It is also found that there was a significant difference in the scientific attitude of the students studying in government-aided
schools and navodaya vidyalayas. The mean scores of scientific attitude is case of students studying in navodaya vidyalayas was higher as compared to government-aided school students.

Thus the hypotheses 4 (c) that there will be no significant difference in the scientific attitude of the students studying in government-aided schools and navodaya vidyalayas was also not retained here.

12. Present study also revealed that there is a significant difference in the scientific attitude of the students studying in private schools and navodaya vidyalayas. The mean scores of scientific attitude in case of students studying in navodaya vidyalayas is higher as compared to the private school students.

Thus the hypotheses 4 (c) that there will be no significant difference in the scientific attitude of the students studying in private schools and Navodaya Vidyalayas was also not retained here.

7.15 EDUCATIONAL IMPLICATIONS

1. The present study would be helpful to the curriculum planners and the teachers in designing the different curricular and co-curricular activities in order to enhance scientific attitude among the students keeping in view different personality traits.

2. As per the findings of the study, intellectual activity and scientific attitude go hand in hand. Therefore the teachers can promote activities which help the child to grow intellectually and ultimately enhancing the scientific bent of mind.
3. The present study also reveals that a healthy interaction between parents and children is required to promote scientific attitude. Therefore, parents are also benefited from the present study. They should provide scientific literature, physical facilities and psychological environment for the proper development of scientific attitude among their children.

4. The results also reveal that there is no significant difference in the scientific attitude of boys and girls. It is thus helpful to the science teachers as it will help them to provide equal opportunities to both boys & girls to promote scientific attitude among them.

5. The present study is helpful to the science teachers to further the scientific attitude of the students by developing proper interest in scientific activities. This can be achieved by organizing science clubs, science fairs, science exhibitions and science quiz etc. in the school.

6. Results of the present study reveal that scientific attitude of English medium students is more developed as compared to Hindi and Punjabi medium students. Similar efforts should therefore be made in Hindi and Punjabi medium schools as well.

7. As per the results, students studying in navodaya vidyalayas have more favourable scientific attitude as compared to those of government, government aided and private school students. It may be due to the fact that techniques adopted by the teachers in navodaya vidyalayas helps in developing such personality traits as experimentation, practical and critical nature among the students, which may be adopted in government, government-aided and privately managed schools.
7.16 SUGGESTIONS FOR FURTHER RESEARCH

1. A study may be conducted on the scientific attitude and its relation to certain personality traits, cognitive and affective variables of graduate students or students of senior secondary stage.

2. A comparative study of the science achievement of high school students having high, average and low scientific attitude may be taken up.

3. The relative efficacy of the scientific aptitude and scientific attitude in relation to personality variables in predicting the science achievement of students at secondary or senior secondary stage may be taken up.

4. Study may be conducted on the influence of study habits, hobbies etc. in the promotion of scientific attitude.

5. Study may be taken up to find out the effect of environmental and psychological factors on the development of scientific attitude.

6. Study may be taken up to find out the effect of different mass media and A.V. aids in promoting scientific attitude.

7. Studies on the role of science club, science exhibition, science museum etc. in developing scientific attitude may be carried out.

8. A comparative study of scientific attitude of different exceptional children in relation to science achievement may be taken up.

9. A study may be conducted on pupil teachers or teachers teaching science in schools or colleges of education.

10. A relationship of scientific attitude, emotional intelligence and general intelligence can be assessed with one or more variables.

11. A comparative study of scientific attitude can be made on the basis of rural and urban students.
12. Replicative studies involving larger and different population, as also follow-up studies maybe undertaken to establish the validity of findings of the present study.